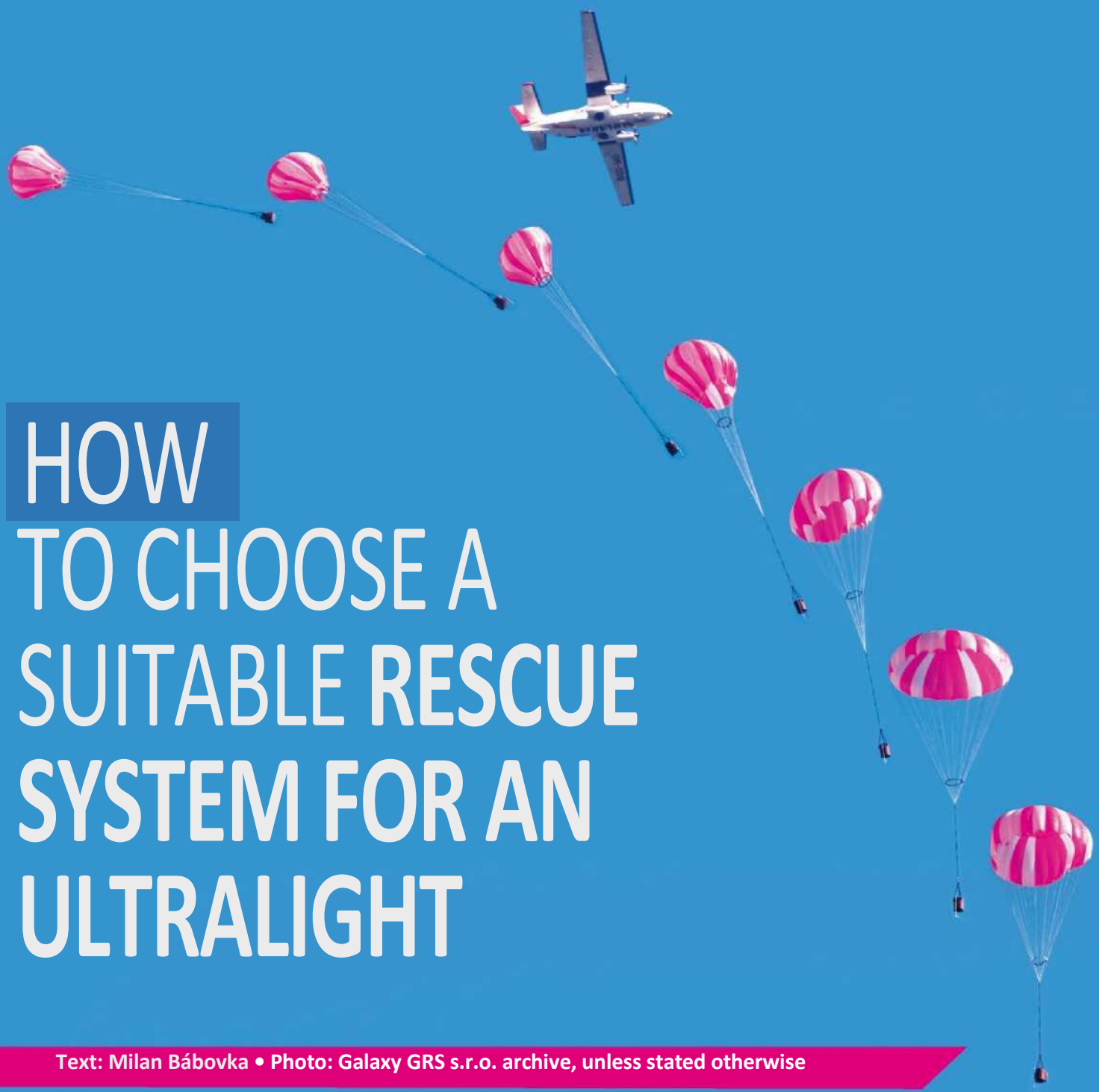


HOW TO CHOOSE A SUITABLE RESCUE SYSTEM FOR AN ULTRALIGHT

Text: Milan Bábovka • Photo: Galaxy GRS s.r.o. archive, unless stated otherwise

MANY ULTRALIGHT MANUFACTURERS ALREADY OFFER THEIR PRODUCTS WITH THE POSSIBILITY OF INSTALLING RESCUE EQUIPMENT (RE), EITHER FROM THEIR VERIFIED SUPPLIER, OR IN THE CASE OF SOME MANUFACTURERS THEY LEAVE IT TO THE CUSTOMER TO CHOOSE THE RE FROM A SPECIALIZED MANUFACTURER OF THIS EQUIPMENT. THEY THEN INSTALL IT IN THEIR PLANE.

Many owners and users own ultralights from a time when it was not common to buy an plane or a motorized hang glider with an already installed RE, or they bought it as an older model without this equipment, and therefore decided to buy this equipment additionally.

Today, both here and abroad, it is no problem to find relevant advertisements in professional aviation magazines, which offer parachutes from companies that deal with this issue and produce RE. But how do you orient yourself in this field, which the average pilot does not know much about? In addition, when you contact a manufacturer, can you be sure that you have made the best choice, because you've approached this particular company, and it is selling you the best parachute currently on the market?

In the following article, I would like to help potential buyers make a decision by highlighting some important conditions for the selection of RE. These are crucial and essential for the possible later use of the RE in a crisis situation that the future user may find themselves in.

If we look at today's categories of ultralights, then we see a wide range of minimum take-off weights (M_{TOW}) up to 600 kg and air speeds ranging from 45 km/h to 380 km/h. For sports aircraft, the weigh is about 2 tons, and air speed is up to 400 km/h.

So how do you choose the right rescue system to be "tailor-made" as much as possible, and not buy a "pig in a poke"?

After learning something about the manufacturer and its product, most people are interested in the weight and size of the RE (so that it does not take up too much space for luggage, or affect the M_{TOW} of the aircraft). Usually, the manufacturer of such equipment will offer a lot of photos of the equipment and tell you who has bought and installed it. Most customers do not know the main thing, because they do not know the main advantages of the right choice for their own particular aircraft.

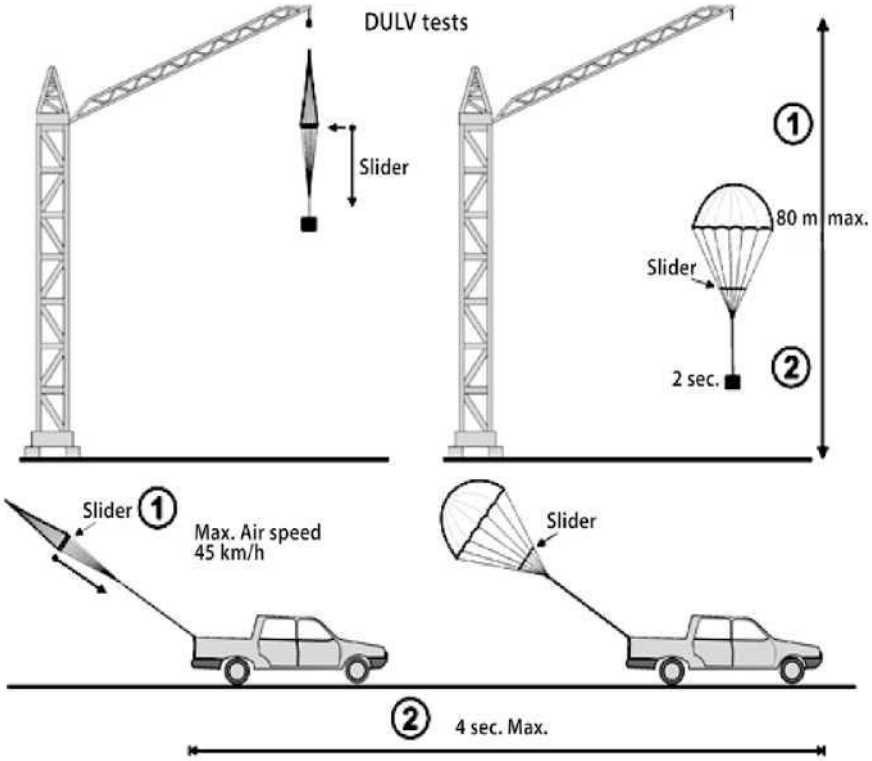
So, the most important information is "what you see is valid". Therefore, no pictures or posters, but a real video from the test of a particular parachute at a specific speed, for example, behind the car on a pole, at least 1.5 m long, with an installed speedometer, pushed out of the car window with the camera recording, and another camera is placed perpendicular to the direction of travel of the test vehicle, from which the parachute in its original packaging and composition is ejected in a vertical trajectory, and the time when it is fully filled with air is recorded. For ultralights weighing up to 473 kg, this test is performed at a speed of 65 km/h. When fully open, the parachute must be completely filled with air within four seconds.

It must also be performed for a motor hang glider fall speed of 45 km/h, and it is a recognized drop test from a crane from a height of 80 m at zero speed above the ground. The parachute must open at least 13-14 m above the ground, and have an impact of two seconds. Parachutes without a slider up to 160 km/h normally pass this test. A parachute for this category is tested behind a vehicle at a speed of 45 km/h and must be fully filled within 4 seconds, including the time of being ejected behind the vehicle.

Currently, there is only one parachute on the market with a slider up to a speed of 260 km/h, which for a weight of 450 kg can handle this cover. It is the Galaxy GRS 5/472.5 parachute, the development of which took a great deal of effort, a lot of testing and ideas, and is used particularly in training aircraft in flight schools around the world.

Therefore, is also necessary to have the following information on the real video: date, type of parachute, its size, current temperature, and pressure in hPa, wind direction and strength, location of the test and who performed it.

This is the basic information for assessing which ultralight the parachute is intended for, and at what height this particular parachute can be used so that it is fully deployed, and the crew and plane can be safely rescued.



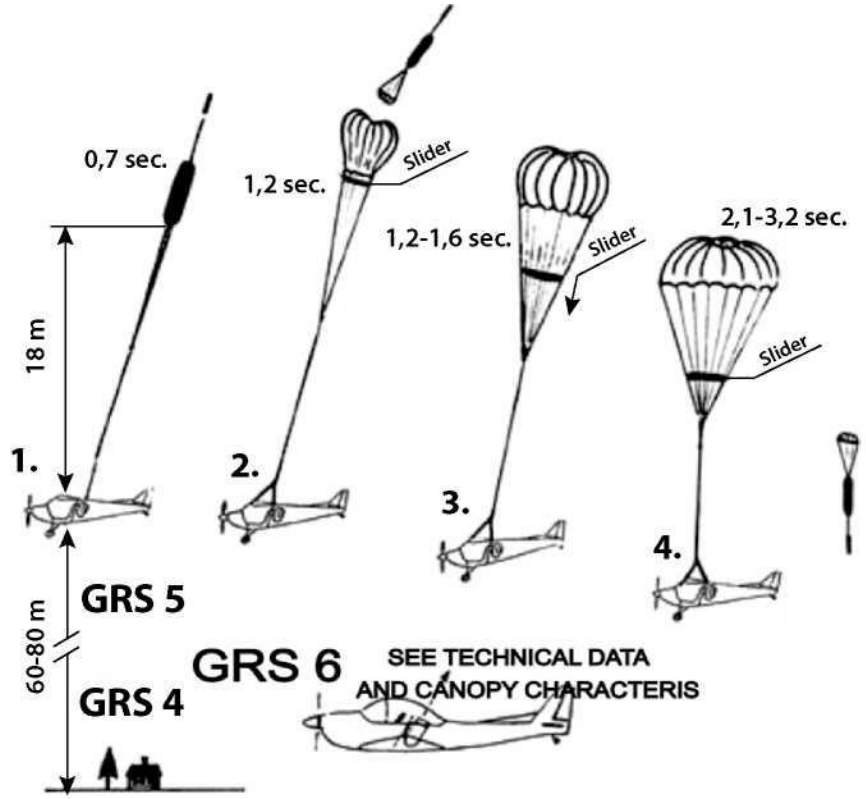
1. *To demonstrate the parachute test at the crash speed of your aircraft and for how long the parachute will open.*
2. *Or on a ground test at 45 or 60 km/h or other, but you always need to see where the slider is located (its starting position is on the cords at the top, near the parachute)!*
3. *Or on a drop test from a crane, aircraft, or helicopter - you always have to see a VIDEO of where the slider is located.*
4. *Always measure the time it takes for the parachute to open, then open our page "rescue during a spin" and calculate according to the given example how the parachute will suit your particular case.*

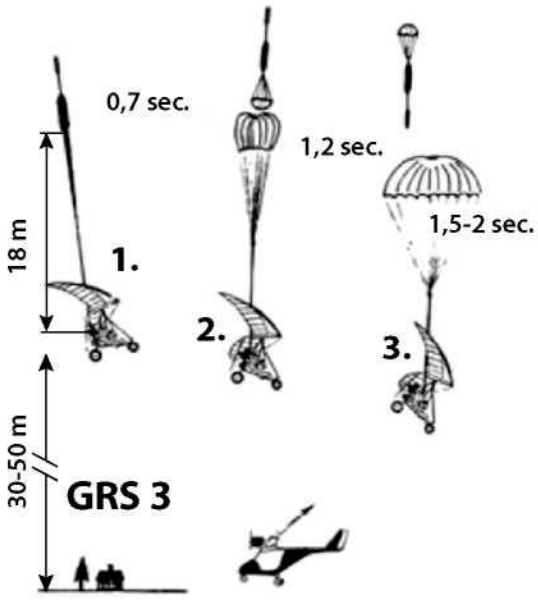
- *From these seemingly trivial things, there is a real chance you will be rescued at a low altitude and low air speed, and at the moment when you unexpectedly lose control of your plane.*

There is no substitute for this test. The LAA CR regulation for RE was created based on years of experience of aviation professionals and is one of the best in the world. Unfortunately, the German DULV test is traditionally more recognized in the EU. Not because it is better, but because there are more aircraft approvals in Germany for the large western part of the EU. It is necessary to pay close attention to the tests performed in Germany, where a performed test is not always 100% guaranteed. Unfortunately, it depends a lot on the people who perform the tests and their links to the RE manufacturer. Our years of experience are testimony to this.

The type of ultralight is key

As I mentioned, when choosing the RE, it is first necessary to focus on the type of ultralight for which you want the equipment. A motor hang glider (MHG) will need a parachute that opens quickly even at low speeds, while most MHG have a V_{NE} (speed limit) of around 140-160 km/h.





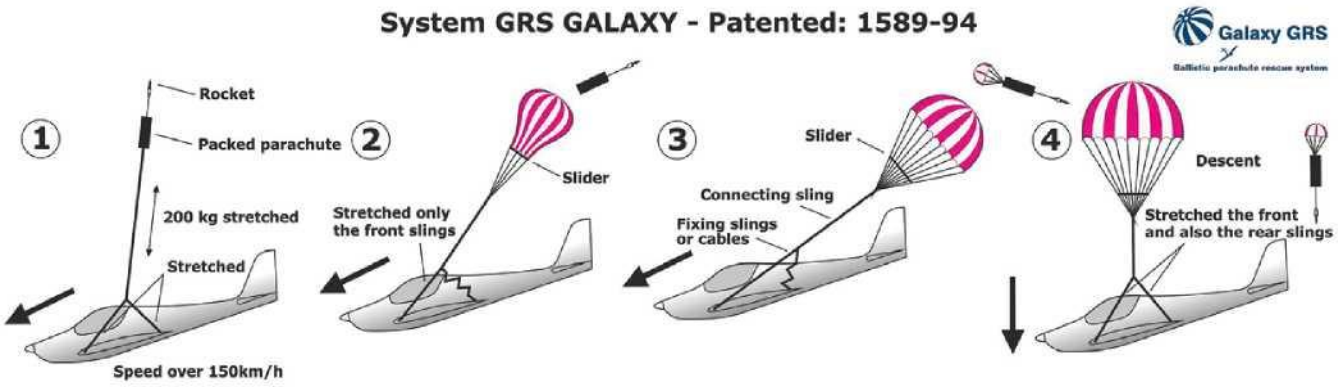
In this case, a parachute without a slider that opens very fast (a rapidly opening brake), where the rescue system can be used at a speed of 45 km/h (typical MHG fall speed) from 30 m above the ground, would be the best choice. A parachute for higher speeds would be insufficient, as it needs to be higher above the ground to open safely, due to the slider installed to maintain speed in order to prevent the parachute from tearing.

Therefore, the first parameter in the selection is the fall velocity of the ultralight and the second parameter is its V_{NE}. Never the other way around!

What needs to be considered is how the designed RE works for rapid opening and rescue even at low altitudes. If a test video is available, and this should always be available when the product is demonstrated, watch how the system works.

A rocket pulls the parachute out of a sleeve or package, and it is important that the rocket engine has a certain power reserve in order for the parachute to reach a safe distance from the damaged or out-of-control aircraft, tighten the parachute cords, lanyards and slings or anchor ropes, and pull the sleeve or cover off the parachute so that nothing prevents it from being filled with the air stream. If this does not happen either because the manufacturer failed to address how the parachute remains in the sleeve until the last moment and ensure that the whole system is stretched, as mentioned before, or the rocket does not have enough energy, so the parachute canopy opens slowly, because the air stream must pull the sleeve with its own force and its speed is several times slower than when the sleeve or package is pulled off by the rocket engine.

Galaxy GRS s.r.o. already has this covered by its patented design from 1994, whereby the rocket does not pull out of a sleeve, but only a package with the parachute to a distance of about 30 m from the aircraft, and can still pull this container off, and descends using a small parachute next to the aircraft, which then descends using its own large parachute together with the crew. This another important parameter for expediting the rapid filling of the parachute canopy at any speed, and is especially important when deploying the parachute at a low height above the ground.



Example 1: **GRS 5/472.5 UL rescue system.**

Manufacturer
Galaxy GRS s.r.o.

Input data:
Weight of the aircraft M_{TOW} = 472.5 kg, air speed V_{NE} = 251 km/h

a) **Measured opening time at 45 km/h ... 3.85 sec.**
b) **Fall speed 6.6 m/sec.**

Minimum rescue height:

$$Ho = \frac{0,5 * g * t^2}{2} + 2 * v_{OT} [m]$$

where:

- g (gravitational acceleration) [g = 9.81 [m/s2]
- t (measured opening time) [s]
- VOP (fall speed of a fully deployed canopy [m/s]

$$Ho = \frac{0,5 * 9,81 * 3,85^2}{2} + 2 * 6,6 = 49,5 [m]$$

When using the reverse configuration system (the aircraft is in a position on its back), 20 m is added to the calculated altitude.

Minimum rescue height is approx.: 49.5 + 20 = **69.5 m (above ground)**

Conclusion:

This system can be used for air speed v = 251 km/h and M_{TOW} = 472.5 kg, or air speed v = 260 km/h and M_{TOW} = 450 kg.

NOTICE:
Now for comparison, another well-known manufacturer

Example 2:
450 XXXXXXXX rescue system
Input data:

a) Measured opening time at 45 km/h ... 8.25 sec.
b) Fall speed 6.0 m/sec.

Minimum rescue height:

$$Ho = \frac{0,5 * 9,81 * 8,25^2}{2} + 2 * 6,0 = 178,7 [m]$$

When using the reverse configuration system (the aircraft is in a position on its back), 20 m is added to the calculated altitude.

Minimum rescue height is approx.: 178.7 + 20 = **198.7 m (above ground)**

This is 4.5 more than the limit prescribed by LAA ČR and DULV!

The philosophy of Galaxy GRS s.r.o. is based on this very idea, i.e., that each group of ultralights must be able to use the parachute at the lowest possible height above the ground upon reaching a certain minimum fall speed. Therefore, Galaxy GRS s.r.o. also performs their own testing and development of their parachutes. The maximum speed is tested only as a subsequent parameter, after the minimum speed for safely opening the parachute canopy is accurately verified for the category of ultralight the parachute is intended for in the future. Unfortunately, some competing manufacturers see it differently, and the subsequent use of their parachutes is somewhat questionable, as the safe rescue at the low fall speed of this or another ultralight can only be guaranteed at 2 or sometimes 3 times the height above ground of the previously described parachute.

World statistics clearly show that 80% of all RE is applied under these conditions, and especially in concentrated airspaces, such as airports, or in areas where they fly together with powered and non-powered ultralights or gliders. These are areas where the pilot is exposed to great stress both from the concentration of aircraft, and possibly from the large number of tasks they have to perform in their aircraft.

So much for the minimum speed of the ultralight and the choice of parachute, which should be chosen so that we use every meter of height for a rescue during a fall, for example, in a spin or from drag, and when we really do not have enough height.

Now to air speed and V_{NE}

Of course, when choosing a suitable parachute, the V_{NE} of our ultralight is also an important parameter. Again, it is necessary to see a video of the test with all the important data. The tested parachute is ejected from the flying aircraft during the test.

L-410, ejection of a weight of 473 to 650 kg from the aircraft at max. 335 km/h

L-410, parachutes outside the aircraft pulled out of a container

L-410, the tested parachute is ejected and begins to fill

The slider on the parachute at the top of the cords and after braking to the required speed

Previously, a Z-37A aircraft was used for this purpose, where instead of the spreader bar under the hopper, a test weight was attached to the ejection belts, and the hopper stored its own parachute. In order to test the parachute at 260 km/h, when the V_{NE} of a loaded Bumblebee did not exceed 180 km/h, the aircraft descended at an angle of 25° and the ripper from the parachute extended for about 15 m. Olda Olšanský developed a program at the Czech Technical University with an algorithm to solve this, and is still used for these tests today (although not with a Bumblebee). The pilot attached a plate to the windscreen with a 15-degree indicator, and during the flight lowered the aircraft to this angle and dropped the weight at a speed of 180 km/h.

Measuring instruments were not available at this time, and everything took place according to the aircraft cabin data. The only reliable dynamic shock data was and still is a copper cone in the dynamometer, which has not changed in 36 years, and is still a reliable strain gauge even in the time of the latest piezoelectric strain gauges. After 2000, when ultralight speeds began to increase, Bumblebee and helicopter ejection were no longer sufficient to correctly perform the tests,

The parachute is fully deployed, and the slider is at the lower edge of the cords...

which must copy the real speed of the ultralight. Therefore, another means was sought for these tests. After a long search, AirDubnica, led by the airport owner, Robert Slosair, who himself owned a L-410, from which parachutes weighing up to 750 kg could be tested at speeds of over 300 km/h, offered a very well-founded service. Many good tests of our parachutes were performed here and testing procedures were verified. We also began cooperating with the Faculty of Mechanical Engineering at Brno University of Technology (BUT), and the Aviation Research Institute. This cooperation has brought the best results for both our company and BUT for the past ten years.

During the flight tests, the parachute must always have the same configuration (carabiner connecting strap, slider, materials used in the system, including cords, etc.) and design as the final sold product. In addition, each parachute is tested three times under the same parameters. During the tests, no damage may occur to any part of the system, otherwise the test is not valid.

How do you design a parachute so that it opens quickly at a low aircraft fall speed and so that it does not damage and rupture at the speed corresponding to the V_{NE} of the aircraft?

During its 36 years of existence, Galaxy GRS s.r.o. has developed a range of high-performance parachutes for all categories of ultralights and sports aircraft with a M_{TOW} of up to 2 tons. In addition to Series 3 parachutes, which do not use a slider and operate in a package at speeds from 30-165 km/h, the company offers Series 4, 5, and 6 parachutes with a dynamic shock brake. I will try to explain to the reader how these parachutes are made and what can be expected from them.

The construction and properties of 4/240, 5/GRS 5/472.5 and GRS 5/560 series parachutes for packages of speeds from 45 km/h to 260 km/h • *The parachute can be simply installed in the aircraft (same assembly for all Galaxy systems*): The rocket engine/rocket is released from the front, and therefore no special fixed steel bracket is needed to mount the rocket, as it has almost no recoil. The rocket is installed directly on the textile cover of the parachute, or separately, and the customer can easily change its position for the most convenient location on the aircraft structure. The total assembly involves only four M5 screws on the parachute and rocket, and two M5 screws on the activating handle mounting.

- ***The parachute has a unique feature for low to zero speeds:*** At low to zero speed, the aircraft recognizes that it must open quickly. It also opens quickly at an aircraft fall speed, at 60 m above the ground at a horizontal speed of 60 km/h, or at zero speed at a height of 75 m above the ground.
- ***The parachute is fast for full deployment:*** At speeds of up to 260 km/h, it can slow down full deployment, so the opening impact is soft and there will never be unwanted overloading or damage to the aircraft or pilot. It always opens within 3.8 sec at both low and high speed.
- ***The parachute is reliable:*** *With a six-year changing cycle, its service life is 30 years in full operation.*
- ***The parachute is designed for UL aircraft with air speeds of up to 260 km/h:*** Great attention was paid to the construction of the parachute. It has a central cord with a slider and a damper system, which opens when filling the canopy and shortens when descending. The dampers open under higher loads and automatically regulates the dynamic impact together with a flexible terminal hole, which dampens the residual dynamic opening impact so that its descent is normal even at a M_{TOW} of 525 kg, which is ideal for pilots from France and Belgium for this category of aircraft at a V_{NE} of up to 200 km/h.
- ***The parachute and its ejecting parts are quickly ejected beyond the aircraft:*** For this category of UL aircraft, our company uses a rocket engine (rocket) with a strong thrust, which is able to eject the entire parachute in the package very quickly within 0.7 seconds above the aircraft, where its cover or short sleeve is pulled off. Only Galaxy parachutes can do this; for other competing parachutes, this cover must be pulled off by the air pressure acting on the parachute, greatly extending its opening time. This has a major effect on the rapid opening of the parachute at low fall speeds. This difference in rescue height is crucial, it is half (or less) the height necessary to open the parachute and rescue the crew and aircraft compared to systems of our competitors. This process is also patented.

Image to give the reader and impression of how big the weight is for the test with 1640 kg of iron. A pitot tube is located on the bent part of the tube coming out of the side of the barrel and is equipped in the movable hinge of the rubber (part of a badminton shuttlecock) so that it can rotate in the direction of the air flow as the barrel flies along its trajectory.

What can Galaxy GRS 6/473 SD to GRS 6/1750-1950 SDS 360 m² parachutes do for packages of speeds from 83 km/h to 400 km/h

- ***The unit as a whole is not complicated:*** The rocket engine/rocket is released from the front, so no special fixed steel bracket is needed to mount the rocket, as it has almost no recoil. The rocket is installed directly on the textile cover of the parachute, or separately, and the customer can easily change its position to the best location on the aircraft structure. The complete assembly includes only four M5 screws on the parachute and rocket, and two M5 screws on the activating handle mounting.
- ***The parachute is smart:*** At a low aircraft air speed, it recognizes that it must open quickly, and also opens quickly at an aircraft fall speed at 90 meters above the ground.
- ***The parachute is fast:*** At a high air speed of over 300 km/h, it can brake the full opening, so the opening impact is soft and there is never an unwanted overload or damage to the aircraft or pilot. It always opens within 4.5 seconds at low and high speeds.
- ***The parachute is reliable:*** If the changing cycle of 6 years is observed, its service life is 30 years in full operation.
- ***The parachute is intelligent:*** Great attention has been paid to the construction of the parachute, and it has a system of flaps (slots) that open when filled and close again when descending.

• Helicopter taking off for a test flight. The weight with the parachute is attached to the landing gear

Other back-up slots open at higher loads and automatically regulate the dynamic shock, as well as a flexible terminal hole, which dampens the residual dynamic impact of the opening so that the descent is normal even at a M_{TOW} of 525 Kg, which is an ideal choice for this category for pilots from France and Belgium. Of course, this identical design is used in most Galaxy GRS parachutes and is also patented worldwide.

- The parachute and its ejecting parts are quickly ejected beyond the aircraft*:* For this category of UL aircraft, our company uses a rocket engine (rocket) with a strong thrust, which is able to eject the entire parachute in the package very quickly within 0.7 seconds above the aircraft, where its cover or short sleeve is pulled off. Only Galaxy parachutes can do this; for competitors' parachutes, this cover must be pulled off by the air pressure acting on the parachute, greatly extending its opening time. This has a major effect on the rapid opening of the parachute at low fall speeds. This difference in rescue height is crucial, it is half (or less) the height necessary to open the parachute and rescue the crew and aircraft compared to systems of our competitors. This process is also patented.
- ***The parachute is very light:*** Using the best materials and a great construction, these parachutes do not need excess fabric on their surface, and their buoyancy slots are used, whiYch partially replace the weight of a large area. The pilot can dedicate the saved weight to better aircraft equipment.

Filling the weight. The tested parachute is located on the upper part of the weight

Galaxy GRS is completely transparent in the field of testing because it shows videos from tests (as the only company in this field) on its website, bYoth from drop and firing tests. It also provides various rescue videos (with the participants' approval) to present its products.